Index 455-101 Series Square CFRP & SS Prestressed Concrete Piles

Design Criteria

AASHTO LRFD Bridge Design Specifications; Structures Detailing Manual (SDM); Structures Design Guidelines (SDG); Fiber Reinforced Polymer Guidelines (FRPG)

Design Assumptions and Limitations

Index 455-101 is the lead standard for the Square CFRP & SS Prestressed Concrete Pile standard series which includes Indexes 455-101 through 455-130. Use this standard with Indexes 455-102, 455-003, 455-112, 455-114, 455-118, 455-124 and 455-130.

Standard piles are designed to have 1000 psi uniform compression after prestress losses without any applied loads to offset tensile stresses that occur during typical driving.

The piles are designed to have 0.0 psi tension using a load factor of 1.5 times the pile self weight during pick-up, storage and transportation as shown in the "Table of Maximum Pile Pick-Up and Support Lengths" on the standard.

Plan Content Requirements

In the Structures Plans:

Show and label the piles on the Foundation Layout, End Bent, Intermediate Bent, Pier, Footing, Typical Section and other sheets as required.

Complete the following "Data Table" in accordance with SDG 3.5 and SDM 11.4 and include it in the contract plans with the "Foundation Layout" sheets. Modify table and notes as required to accommodate the required number of piles, piers and/or bents, use of Test Piles and instrumentation. When not enough space is available on one plan sheet, continuations of the Data Table and/or separate pile cut-off elevation tables are acceptable. See Introduction I.3 for more information regarding use of Data Tables.

For projects without Test Piles change data table column heading "TEST PILE LENGTH (ft.)" to "PILE ORDER LENGTH (ft.)".
### PILE DATA TABLE

<table>
<thead>
<tr>
<th>INSTALLATION CRITERIA</th>
<th>DESIGN CRITERIA</th>
<th>PILE CUT-OFF ELEVATIONS</th>
</tr>
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<tbody>
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#### PILE INSTALLATION NOTES

- **Ultimate Side Friction Capacity**
  - The ultimate side friction capacity must be obtained below the 100-year scour elevation to resist pullout of the pile. (Signify only when design requires uplift capacity.)

- **Total Scour Resistance**
  - An estimate of the ultimate static side-friction resistance provided by the soil. The resistance is reduced by the factor of safety for the scour resistance.

- **Net Scour Resistance**
  - An estimate of the ultimate static side-friction resistance provided by the soil. The resistance is reduced by the factor of safety for the scour resistance.

- **100-Year Scour Elevation**
  - The elevation is the 100-year storm event.

- **Contractor’s Notes**
  - Verify location of all utilities prior to pile installation activities.
  - When jetting is required, the jet pipe shall be lowered to the elevation and continue to operate at this elevation until the pile driving is complete. If jetting or pounding elevations differ from those shown in the table, the Engineer shall be responsible for determining the required driving resistance.
  - No jetting will be allowed without the approval of the Engineer.
  - The Contractor shall not determine the allowable pile diameter or required jet elevation, whichever is greater.
  - At each pile, pile driving is to commence at the center of the berm and proceed outward.
Payment

<table>
<thead>
<tr>
<th>Item number</th>
<th>Item Description</th>
<th>Unit Measure</th>
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</thead>
<tbody>
<tr>
<td>455-34-ABB</td>
<td>Prestressed Concrete Piling (CFRP or SS)</td>
<td>LF</td>
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</table>

Design Aids
**12" SQUARE PRESTRESSED CONCRETE PILE INTERACTION DIAGRAM**

- (4) 0.6" Dia., CFRP
- (4) 1/2" Dia., CFRP
- (8) 1/2" Dia., HSSS
- (8) 1/2" Dia., Carbon Steel (Black)
- (4) 0.6" Dia., Carbon Steel (Black)

**Design Assumptions:**
- Concrete compressive strength $f_c = 6,000$ psi.
- Modulus of elasticity of prestressing strands, $E_p = 18,000$ ksi (1/2" CFRP), 22,480 ksi (0.6" CFRP), 23,500 ksi (HSSS) & 28,500 ksi (Carbon-Steel).
- Resistance factors $\phi$ based on ACI 440.4K for CFRP strands (0.75 compression-controlled, 0.85 tension-controlled), and AASHTO LRFD 5.5.4.2.1 for HSSS & Carbon-Steel strands (0.75 compression-controlled, 1.0 tension-controlled).
- All piles assumed to have spliced ties.
- Strand sizes and strand patterns used to create interaction curves correspond with those indicated in Index 455-112 for CFRP & HSSS and Index 455-012 for Carbon-Steel.
Design Assumptions:

- Concrete compressive strength $f'_c = 6$ksi.
- Modulus of elasticity of prestressing strands, $E_p = 18,000$ ksi (1/2" CFRP), 22,480 ksi (0.6" CFRP), 23,500 ksi (HSSS) & 28,500 ksi (Carbon-Steel).
- Resistance factors $\phi$ based on ACI 440.4R for CFRP strands (0.65 compression-controlled, 0.85 tension-controlled), and AASHTO LRFD 5.5.4.2.1 for HSSS & Carbon-Steel strands (0.75 compression-controlled, 1.0 tension-controlled).
- All piles assumed to have spiral ties.
- Strand sizes and strand patterns used to create interaction curves correspond with those indicated in Index 455-112 for CFRP & HSSS and Index 455-012 for Carbon-Steel.
**18" SQUARE PRESTRESSED CONCRETE PILE INTERACTION DIAGRAM**

- **(12) 0.6" Dia., CFRP**
- **(12) 1/2" Dia., CFRP**
- **(16) 1/2" Dia., HSS**
- **(12) 1/2" Dia., Carbon-Steel (Black)**
- **(12) 0.6" Dia., Carbon-Steel (Black)**

**Design Assumptions:**
- Concrete compressive strength $f_c = 6$ ksi.
- Modulus of elasticity of prestressing strands, $E_p = 18,000$ ksi (1/2" CFRP), 22,480 ksi (0.6" CFRP), 23,500 ksi (HSS), & 28,500 ksi (Carbon-Steel).
- Resistance factors $f$ based on ACI 440.4R for CFRP strands (0.65 compression-controlled, 0.85 tension-controlled), and AASHTO LRFD 5.5.4.2.1 for HSSS & Carbon-Steel stands (0.75 compression-controlled, 1.0 tension-controlled).
- All piles assumed to have spiral ties.
- Strand sizes and strand patterns used to create interaction curves correspond with those indicated in Index 455-118 for CFRP & HSS and Index 455-018 for Carbon-Steel.
**24" SQUARE PRESTRESSED CONCRETE PILE INTERACTION DIAGRAM**

- **(16) 0.6" Dia., CFRP**
- **(16) 1/2" Dia., CFRP**
- **(20) 1/2" Dia., HSSS**
- **(24) 1/2" Dia., Carbon Steel (Black)**
- **(16) 0.6" Dia., Carbon Steel (Black)**

**Design Assumptions:**
- Concrete compressive strength $f_c = 6$ ksi.
- Modulus of elasticity of prestressing strands, $E_p = 18,000$ ksi (1/2" CFRP), 22,430 ksi (0.6" CFRP), 23,500 ksi (HSSS), & 28,500 ksi (Carbon-Steel).
- Resistance factors $\phi$ based on ACI 440.4R for CFRP strands (0.65 compression-controlled, 0.85 tension-controlled), and AASHTO LRFD 5.5.4.2.1 for HSSS & Carbon-Steel strands (0.75 compression-controlled, 1.0 tension-controlled).
- All piles assumed to have spiral ties.
- Strand sizes and strand patterns used to create interaction curves correspond with those indicated in Index 455-124 for CFRP & HSSS and Index 455-024 for Carbon-Steel.
Design Assumptions:
- Concrete compressive strength $f_c = 6$ ksi
- Modulus of elasticity of prestressing strands, $E_p =$ 18,000 ksi (1/2" CFRP), 22,480 ksi (0.6" CFRP), 23,500 ksi (HSSS), & 28,500 ksi (Carbon-Steel)
- Resistance factors are based on AASHTO LRFD 5.4.1.4 for CFRP strands (0.85 compression-controlled, 0.88 tension-controlled), and AASHTO LRFD 5.5.4.2.1 for HSSS & Carbon-Steel strands (0.75 compression-controlled, 1.0 tension-controlled).
- All piles assumed to have spiral ties.
- Strand sizes and stand patterns used to create interaction curves correspond with those indicated in Index 455-130 for CFRP & HSSS and Index 455-330 for Carbon-Steel.